MERCURY IN STEEL – Mass Loading, Distribution & Chemical Reduction

Oil and gas companies across the globe are faced with aging infrastructure leading to significant decommissioning challenges. Particular attention should be considered when developing decommissioning strategies for process systems previously or currently exposed to mercury-impacted hydrocarbon streams. Two key considerations required for the development of safe decommissioning strategies are: 1) understanding the nature and distribution of mercury in pipelines and process equipment, and 2) consideration of mercury decontamination goals, i.e., establishing criteria for measurement of performance and completion of the decontamination.

ISCT provides consulting services globally on the interaction of mercury with steel surfaces, and has completed multiple ground-breaking research and development projects defining mass loading, distribution, and mercury speciation of mercury in steel.
As part of that understanding we deploy specialized technologies and methods to obtain the information required as part of the mass flux, loading and distribution models.

Mercury adsorbs and chemisorbs to carbon steel surfaces, primarily through amalgamation and diffusion into the steel matrix and scale, making carbon steel and stainless steel excellent mercury scavengers. Fortunately, this process can be reversed depending on the many depositional factors (what goes in can come out). However, mercury complexed and incorporated into steel surfaces is not easily removed by typical hydrocarbon chemical decontamination chemistries and methods. The research group at ISCT has concentrated efforts on understanding sorption dynamics of mercury in steel pipe and equipment, and has developed effective chemical decontamination formulations for contaminated process systems. Bench-scale and pilot-scale studies using steel coupon samples from impacted process equipment have been a key component of evaluating mercury decontamination methods

CONSULTING SERVICES:

- Bench scale testing of metallic test coupons to develop and support cost effective mercury decontamination chemical development and chemical cleaning programs
- Design/implement research and development programs to support asset mercury management:
- Marine assets: FSOs, FPSOs, Riser Platforms, Production Platforms, Gathering Platforms
- Onshore processing assets: Dehydration Plants, Gas Plants, NGL and LNG plants
- Total asset mercury management planning -riser platform to onshore processing
- Design and implementation of mercury chemical decontamination of offshore and onshore process systems for continued use and decommissioning

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and chemistries, and are used to identify the most cost-effective technology for decontaminating mercury impacted equipment (process equipment i.e., sub-sea pipelines, topside processing equipment and FPSO cargo holds).

Members of ISCT have developed mercury-inert chemical reaction test chambers and bench/pilot test systems to subject mercury-impacted test coupons to various chemical solutions while controlling and continuously monitoring process parameters (pH, temperature, dissolved Fe, Total Hg, Particulate Hg, Volatile Hg, Dissolved Hg). Test coupons can also be subjected to varying chemical application methods (i.e., foam, gel, vapor phase, cascade, robotic, directed pressure, chemical pig trains, full circulation) and the performance and efficacy of these methods/chemical combinations measured precisely.

Understanding the nature and distribution of mercury along with depth profiles in carbon and stainless steel process equipment is critical to developing decontamination and decommissioning goals and criteria. Examples of decontamination/decom criteria could be based on reuse or recycling of salvaged material, worker safety when involving hot-work, and environmental exposure from abandonment-in-place solutions. Ultimately, the degree of removal of mercury from impacted equipment and piping will be driven by the depositional environment (e.g. duration of exposure to process and mercury concentration of process streams) as they relate to these criteria and considerations. Effective chemical decontamination or decommissioning planning will be based on the full understanding of the uptake of mercury and mercury compounds to process equipment surfaces, providing valuable information to verify components of mercury mass flux and distribution models, and to develop effective chemical decontamination solutions. ISCT and our partners have the expertise and experience to accomplish these goals.

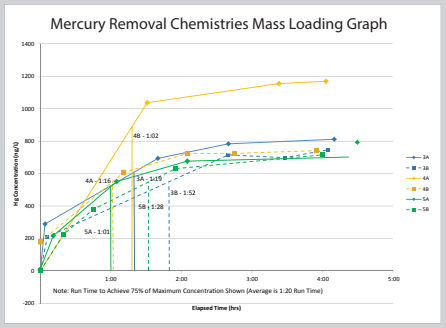

Fig 1: PEI chemical formulations mercury uptake over time

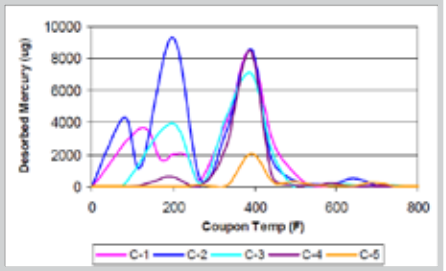

Fig 2: Thermal Desorption results of pre and post chemical treated mercury impacted metal coupons

Fig 3: Thermal desorption unit and Sulfinert crucible used for thermal desorption testing of metal coupons

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